REMARKS

Claims 1-12 were pending in the present application. By this Amendment, new independent claim 13 has been added, and claim 1 has been amended to clarify the claimed invention. Accordingly, claims 1-13 are pending in the present application, with claims 1, 7 and 13 being in independent form.

Support for the amendment to claim 1 can be found in the application at, for example, page 13, line 31 through page 14, line 1.

Support for new claim 13 can be found in the application at, for example, page 10, line 29, through page 12, line 4.

Rejection under Sect. 112, first paragraph (written description)

On page 2 of the November 4, 2004 final Office Action, claims 1-12 were rejected under 35 U.S.C. §112, first paragraph, as allegedly failing to comply with the written description requirement.

The Examiner stated that the claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The Examiner also stated that this is a new matter rejection.

The Examiner stated that this rejection is maintained for reasons of record. The Examiner further stated that claim 1-12 are original claims, however, they have been substantively amended several times. The Examiner also stated that Applicant has pointed to basis in the appendix (pages A-1 through A-7) to the

response.

The Examiner stated that comparison of independent claims 1 and 7 alone to the basis pointed to in applicant's chart reveals that basis for the system of claim 1 is premised on Fig. 1 and pages 12-16 and 20-21 of the specification and that basis for the process of claim 1 is premised on pages 10-16 and 20-22 of the specification. The Examiner further stated that the system components and method steps set forth here neither match those of the claims in a broad sense or in particulars.

The Examiner stated that for example, Fig. 1 has all of the components linked to a central control apparatus and genomics database which is not a limitation of the claims. The Examiner further stated that the control apparatus and database are one unit. The Examiner also stated that components 6, 7 and 8 are also linked which is not a limitation of the claims.

The Examiner stated that a fair reading of the specification as originally filed would not convey to one of ordinary skill in the art that what is now claimed was the contemplated invention. The Examiner further stated that Applicant may not recast or repackage the method steps originally contemplated into different combinations after the fact. The Examiner also stated that the presently claimed methods as written are conceptually different from those claims originally filed and the methods disclosed in the specification as filed and the constitute new matter.

The Examiner states in the second paragraph on page 3 of the November 4, 2004 Office Action that additional features must be added to the system claim.

While Applicants do not concede the Examiner's contention, claim 1 has been amended in this Amendment to clarify the claimed invention described in the claim.

Regarding links between components 6-8 in Figure 1, as pointed out in the specification (see page 22, lines 19-25), it is desirable to use robotics and other automation techniques in the process and system. The links between components 6-8 suggest by way of example that transfer of specimen crystals from component 6 to component 7 and then from component 7 to component 8 may be automated. Automation is not a requirement but an option according to the patent specification.

In addition, it should be noted that the written description rejection was asserted by the Examiner for the first time in the April 26, 2004 Office Action. The April 26, 2004 Office Action did not state any specifics regarding which features of the claimed invention constitutes new matter. Instead, the April 26, 2004 Office Action requested Applicants to identify support in the application for each claim element. In response to the Examiner's request, Applicants submitted a seven page chart citing such support.

The November 4, 2004 Office Action does not set forth any specifics regarding which features of the claimed invention constitutes new matter.

Applicants request the Examiner to identify specifically the features of the claimed invention that the Examiner contends constitute new matter.

Applicants maintain that the claimed invention has not changed

during the course of prosecution (since the cited art does not require the breadth of the claimed invention to be narrower), and claims 1-12 have been amended (numerous times) to place them in better form for examination, in response to Office Actions which stated that the claims do not clearly define the claimed invention.

Accordingly, withdrawal of the written description rejection of claims 1-12 under 35 U.S.C. §112, first paragraph, is respectfully requested.

Rejection under 35 U.S.C. §112, first paragraph (enablement)

On page 3 of the November 4, 2004 final Office Action, claims 1-12 were rejected under 35 U.S.C. §112, first paragraph, because the specification purportedly does not provide enablement for the breadth of what is encompassed.

The Examiner stated that the specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention commensurate in scope with these claims.

The Examiner stated that claims 1-6 are directed to a system comprising a database, at least one bioinformatics tool, a protein synthesis means having a screening means, a protein processing means, a crystallization means, an X-ray crystallography means, a structure extraction means, and a homology model building tool. The Examiner also stated that the prior Office Action sets forth the reasons that these systems claims do not make clear whether the claimed system is an integrated, turn-key system or fully automated system or whether it embraces discrete components that are not physically,

structurally, or functionally related.

The Examiner stated that for example, the claims recite no limitations with respect to how the screening means is interrelated or associated with the structure extraction means, if at all. The Examiner further stated that the term "system" does not appear to imply some interrelationship. The Examiner also stated that interpreting the claim using an English language definition, Webster's defines a "system" as "regularly interacting or interdependent group of items forming a unified whole".

The Examiner stated that the prior Office Action sets forth the reasons that claims 1-6 are considered to encompass an integrated, turn-key system and/or fully automated system is not enabled. The Examiner further stated that Applicant is reminded that an adequate disclosure of a device requires details of how complex components are constructed and perform the desired function, particularly if the specification does not detail how the parts should be interconnected and controlled. The Examiner also stated that block diagrams with functional labels do not indicate whether the parts are "off the shelf" or must be specifically constructed or modified for applicant's system.

The Examiner stated that Applicant's arguments regarding beamtime being readily leased by general users are persuasive. The Examiner further stated that there is no argument nor evidence of record that such synchrotron facilities would permit physical, structural, or functional connection with any or all of the devices set forth in the claims.

The Examiner stated that Applicant is requested to explicitly set

forth on the record what they believe the claimed system is directed to with respect to integration of components or lack thereof.

The Examiner stated that with respect to claims 7-12, the claimed method fails to particularly point out what steps are to be performed and how they are to be performed. The Examiner further stated that this portion of the rejection is maintained for reasons of record.

The Examiner stated that Applicant has argued 35 USC 112, sixth paragraph. The Examiner further stated that the claims have not been treated under 35 USC 112, sixth paragraph. The Examiner also stated that Applicant must show why the claim language invokes 35 USC 112, sixth paragraph, with respect to these claims.

The Examiner stated that Applicant is requested to point to the particular means specified in the written description and equivalents thereof to perform the particular function. The Examiner further stated that it does not appear that the corresponding structure, material, or acts set forth in the written description necessary to perform the function. The Examiner also stated that this decision is not germane to enablement as it addresses indefiniteness under 35 USC 112, second paragraph and in the instant application, the specification is no more illuminating than the claims with regard to the positive, active steps to perform.

In response, Applicants respectfully traverse the rejection.

The issue of whether the claimed system covers an integrated,

turn-key system or fully automated system is clearly an issue of breadth, not enablement. Thus, the real issue is whether Claim 1 having such a breadth impinges upon the prior art. The Examiner has failed to demonstrate such impingement which would require Applicants to make more narrow the scope of the claimed invention.

Applicants maintain that the application provides an enabling disclosure for such an automated system.

For example, the application, page 22, lines 19-25, states as follows:

> At all steps of the process, parallel technology including robotics and other automation may be used. Subject materials may be monitored and logged at each step, and process control data of this kind may be used to optimize the procedures. Records maintained on subjects that do not advance may be used to reinitiate such experiments as advanced procedures are implemented.

The application also includes additional suggestions for using robotics and other automation techniques. See, for example, page 15, lines 19-20, page 16, lines 26-27.

Moreover, use of robotics and automation processes are well-known in the art. Numerous off-the-shelf robotics and automation components are commercially available. Although adaptations and programming may be made, one skilled in the art with the suggestions and guidance provided by this application would readily be able to implement such robotics and automation processes. In addition, implementation may involve assorted designer's choices unaffected by the specifics of the claimed invention.

Regarding connections to the synchrotron facilities, attached as Exhibit A are computer printouts of web pages regarding facilities at, as one example, the Argonne National Laboratory (ANL) Advanced Photon Source (APS), to the over two thousand users conducting research at the APS. Users can use the existing facilities or submit proposals for construction of new facilities or modification of existing facilities. It is noted that not all components of the system need to be on-site. For example, data can be communicated to and from the APS through one or more computer or other telecommunicative (for example, dial-up or broadband) networks.

The Office Action states that the claimed method of claims 7-12 fails to particularly point out what steps are to be performed (that is, rather than an issue of enablement which requires one to look to the disclosure, the Examiner objects to the claim terms as being indefinite). The issue of particularity of claim terms clearly is one of definiteness for which one looks to claim terms, as opposed to one of enablement for which one looks to the specification for enabling disclosure.

None of the bases in the record for this contention show that a claim term fails to meet the requirements of 35 U.S.C. §112 definiteness. Instead, this contention is based on the premise that not enough details is provided **in the claims**, or stated another way the claims are too broad. However, breadth is not an issue of indefiniteness. Instead, when breadth is at issue, the question is whether claims having such a breadth impinges upon the prior art. prior art

In sum, the record fails to show that the claims are indefinite or nonenabled.

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claims 1-12 under 35 U.S.C. §112, first paragraph.

Rejection under 35 U.S.C. §112, second paragraph

On page 5 of the November 4, 2004 final Office Action, claims 1-12 were rejected under 35 U.S.C. §112, second paragraph, as allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The Examiner stated that "claims 1 and 7 recite 'homologous sequences.'" The Examiner further stated that "it is unclear what level of homology is required to meet the limitation of the claim."

The Examiner stated that claims 1 and 7 recite 'a plurality of target proteins which are members of the family.' The Examiner also stated that "the criteria that define a family are not provided." The Examiner further stated that "it is unclear how a target is selected (what parameters or criteria are used) and how many targets are selected."

The Examiner stated that Applicant argues that various know programs can be used and that one of ordinary skill in the art would not find these two phrases unambiguous and this is unpersuasive. The Examiner also stated that the claims and specification must particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner further stated that Applicant has not provided an art understood meaning for these phrases either within the

specification or using art recognized documentation.

The Examiner stated that claims 1 and 7 have been amended to recite "which are effective as the target proteins." The Examiner also stated that it is not known what is meant by this phrase. The Examiner further stated that what defines an effective target protein.

The Examiner stated that claims 1 and 7 have been amended to recite "screening products of the synthesis to choose selected synthesized products for processing." The Examiner further stated that "the criteria or parameters for the selection are not provided."

The Examiner stated with respect to claims 1-6, the claimed system does not set forth the relationship of the database, bioinformatics tool, protein synthesis means, protein processing means, crystallization means, X-ray crystallography means, and so forth. The Examiner also stated that the claim language does not reflect an integrated or turn-key system where the components are related or linked to each other in some fashion. The Examiner further stated that as written, the claim appears to be directed to a collection of laboratory equipment or machines.

The Examiner stated that a collection of laboratory equipment or machines does not define a system. The Examiner also stated that Applicant's response on page 18 indicates that the claim is not limited to a turn-key system.

The Examiner stated that with respect to claims 7-12, the method steps as written are internally inconsistent and unclear. The Examiner also stated that for example, in step (a) the database

has sequence information for a first plurality of proteins and structural information and function information for a second plurality of proteins. The Examiner further stated that in step (g), the refined model is stored in the database.

The Examiner stated that part (a) does not require that the structural information include a refined model or a homology model. The Examiner also stated that in step (j), the database is updated to link the refined model to other databases. The Examiner further stated that part (a) does not require that the database have links to any information at all.

Applicants traverse the rejection as follows.

As previously noted, all of the bases provided by the Examiner under the rubric of "indefiniteness" actually solicit claim amendments to limit the claims. However, breadth of claim cannot support an indefiniteness rejection.

MPEP 2173.04, states that "[b]readth of a claim is not to be equated with indefiniteness. *In re Miller*, 441 F.2d 689, 169 USPQ 597 (CCPA 1971). If the scope of the subject matter embraced by the claims is clear, and if applicants have not otherwise indicated that they intend the invention to be of a scope different from that defined in the claims, then the claims comply with 35 U.S.C. 112, second paragraph."

For example, regarding the terms "homologous sequences" the Examiner clearly understands the term, but the Examiner states that the claim must recite in addition the level of homology, in order to further limit the claim. The Examiner has entirely and consistently failed to address the points that Applicants have

previously provided.

For example, Applicants have previously pointed out in the record regarding level of homology and criteria for a family that the application provides, for example, the following additional guidance at page 14, lines 3-16:

> "Three dimensional structural information may be exploited in conjunction with recent advances in amino acid sequence analysis to construct the database. Advanced bioinformatics tools 2 are used to cluster all known gene products into families of homologous sequences. The clustered gene products are typically similar at approximately 30% identity, <0.001 probability of error. The structure of a representative member for each and every family is determined. The protein classes may include whole proteins, domains or sequence motifs that may or may not correspond to independent modules. The unsolved members, which probably constitute the majority, of each family may be visualized by homology modeling based on the known structures of family representatives, as described below."

In addition, regarding "a plurality of target proteins which are members of family" the claims specify that the members of a family have homologous sequences. Applicants have made these points previously and the Examiner has neither acknowledged nor addressed these points.

As Applicants have also previously pointed out in the record, patent claims define the bounds, **but not necessarily the details**, of the claimed invention. That is, patent claims need not teach one of ordinary skill in the art how to practice the claimed invention which is the function of the specification (rather than the claims).

Regarding "synthesized products which are effective as the target proteins" and "screening products of the synthesis to choose selected products for processing", it is well known (and

conventionally known) to one skilled in the art that not all of the products of a protein synthesis process (for example, cloning, chemical synthesis, etc.) are necessarily the target protein. For example, one would conventionally screen for expression the constructs resulting from a cloning process. Similarly, one would screen (or filter) the products of chemical synthesis which may include constructs other than the target protein. Thus, one skilled in the art (who by definition knows and/or are in possession of the conventional art) would clearly understand the claim terms, without further elaboration in the claim.

With respect to system claims 1-6, contrary to the contention in the Office Action, the claim elements do have a functional relationship. Contents of the database are used by the bioinformatics tool to cluster proteins into families. For each such family determined by the bioinformatics tool, the protein synthesis means synthesizes target proteins which are members of that family. The protein processing means processes selected products synthesized by the protein synthesis means. The crystallization means crystallizes synthesized products processed by the protein processing means, to produce specimen crystals. The X-ray crystallography performs crystallography on crystals produced and selected by the crystallization means. Thus, it is clear that the claim elements are linked by their respective functional roles. This has previously been pointed out in the record, and the Examiner has neither acknowledged nor addressed the points made by Applicants.

Regarding method claims 7-12, it is clear from the specification that the database may have sequence and structural information for a protein for not functional information for the protein.

Thus, the "first plurality of proteins" is not identical to the "second plurality of proteins". This distinction does not require partitioning of the database. For example, in a relational database, the functional information field for a protein which is one of the "first plurality of proteins" and not one of the "second plurality of proteins" will simply be empty or null (or some equivalent representation).

Regarding the contents of the database, the Examiner appears to fail to understand (notwithstanding the guidance provided in the specification) that the content of the database is dynamic. That is, as information is collected (for example, structural information, atomic models, refined model, homology models, functional information, etc.) the information is used to update the database. Database update can include replacing old information, adding new information to an existing field, creating a new database field or object, adding links to information elsewhere, etc. Applicants find no inconsistency amongst steps (a), (g), (j) or any other recited step.

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claims 1-12 under 35 U.S.C. §112, second paragraph.

Rejection Under 35 U.S.C. §102(a)

On page 7 of the November 4, 2004 Office Action, claims 1-12 were rejected under 35 U.S.C. §102(a) as allegedly anticipated by knowledge of others in this country before the invention thereof by Applicant, as purportedly evidenced by

(1) the Workshop on Structural Genomics held at Argonne National Laboratories held January 1998,

(2) National Institute of General Medical Sciences (NIGMS)

Protein Structure Initiative (PSI) held April 24, 1998 (hereinafter "the NIGMS PSI paper"),

(3) NIGMS Genomics Project Planning Meeting held November 24, 1998,

(4) Structural Genomics Meeting held October 1998 in Avalon, New Jersey,

(5) Shapiro et al. (Current Biology, 15 March 1998), and

(6) Gaasterland (Nature Biotechnology, July 1998).

The Examiner stated that this rejection is maintained for reasons of record. The Examiner further stated that Applicant continues to argue with respect to publication dates. The Examiner also stated that the effective filing date of the instant application is January 22, 1999.

The Examiner stated that Shapiro and Gaasterland are prior art by publication date. The Examiner further stated that the remaining references are applied for what they collectively teach was know in the art at the time of the invention.

The Examiner stated that 35 USC 102(a) is not limited to description in a printed publication before the invention thereof by the applicant for patent. The Examiner also stated that it includes whether the invention was known by others in this country before the invention thereof by the applicant for a patent. The Examiner further stated that the fact that this meeting (as well as the other meeting cited above and publication discussing the meetings cited above) took place or were published prior to applicant's filing date indicates that the invention was known. The Examiner also stated the content of what was discussed at each of these meetings prior to the filing date of the invention has not been rebutted by Applicants.

The Examiner stated that exhibits presented from inventor Hendrickson support the Examiner's position as set forth in the prior office action. The Examiner further stated that Applicants argue with respect to enabling disclose. The Examiner also stated that is it not clear from the arguments what they are arguing is not enabled.

The Examiner stated that with respect to the system of claims 1-6, applicant continues to argue with respect to the interpretation of the term "system" in claims 1-6. The Examiner further stated that according to Webster's dictionary a system is "a regularly interacting or interdependent group of items forming a unified whole". The Examiner also stated that this is the basis for the Examiner's questioning under 112, first and second paragraph, as to how the recited components in the system of claims 1-6 are supposed to be linked or integrated, whether the intent was a turn-key system or discrete and independent components.

The Examiner stated that these claims do not require that the output from means must be in a form to act directly, automatically, seamlessly, or otherwise, as input for the next means. The Examiner further stated that each of these discrete components (a database with sequence, structural, and functional information; at least one bioinformatics tool capable of clustering; protein synthesis means with screening means; protein processing means; crystallization means; X-ray crystallography means; structure extraction means able to build a refined model; and a homology building tool) having the functionality required by the claims, would have been discussed at these various meetings and thus the system as claimed would have been known.

The Examiner stated that the embodiment of the system where the components are integrated to the degree that the output of one means could be used by another means, for example the protein synthesized by the protein synthesis means used by the crystallization means, would also clearly have been known. The Examiner further stated that the use of multiple known methodologies in combination to solve the structural genomics problem was clearly known at the time of the invention.

Applicants traverse the rejection.

The rejection is based on references (1) through (6) representing six separate and distinct pools of knowledge.

As previously pointed out in the record, it is well-established that anticipation under 35 U.S.C. §102 requires that each and every feature of a claimed invention must be disclosed in a single reference. It is impermissible to base a rejection under 35 U.S.C. §102 on multiple references disguised as "knowledge by others".

The Examiner has not specified where each and every feature of the claimed invention can be found in a single reference. Absent such a showing, the rejection cannot stand.

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claims 1-12 under 35 U.S.C. §102(a).

Rejection under 35 U.S.C. §102(f)

On page 9 of the November 4, 2004 final Office Action, claims 1-

12 were rejected under 35 U.S.C. §102(f) because the applicant purportedly did not invent the claimed subject matter in view of

(a) the Workshop on Structural Genomics held at Argonne National Laboratories held January 1998,

(b) NIGMS PSI meeting held April 24, 1998,

(c) NIGMS Genomics Project Planning Meeting held November 24, 1998,

(d) Structural Genomics Meeting held October 1998 in Avalon, New Jersey, and

(e) Gaasterland.

The Examiner stated that this rejection is maintained for reasons of record.

The rejection is based on references (a) through (e) representing five separate and distinct disclosures.

As previously pointed out in the record, it is well-established that anticipation under 35 U.S.C. §102 requires that each and every feature of a claimed invention must be disclosed in a single reference.

The Office Action simply has not demonstrated that the claimed invention was known or made by another (i.e. a single reference) prior to when the invention was made by Applicants. The Examiner has not specified where each and every feature of the claimed invention can be found in a single reference. Absent such a showing, the rejection cannot stand.

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claims 1-12 under 35 U.S.C. §102(f).

In view of the remarks hereinabove, Applicants maintain that claims 1-13 are now in condition for allowance. Accordingly, Applicants earnestly solicit the allowance of claims 1-13.

If a telephone interview would be of assistance in advancing prosecution of the present application, Applicants' undersigned attorney invites the Examiner to telephone him at the telephone number provided below.

If a petition for an extension of time is required to make this response timely, this paper should be considered to be such a petition, and the Commissioner is authorized to charge the requisite fees to our Deposit Account No. 03-3125.

No fee is deemed necessary in connection with the filing of this response. However, if any additional fee is required, authorization is hereby given to charge the amount of any such fee to Deposit Account No. 03-3125.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited this date with the U.S. Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

February 4, 2005
Date

Paul Teng
Reg. No. 40,837

Advanced Photon Source
A U.S. Department of Energy, Office of Science,
Office of Basic Energy Sciences national synchrotron
x-ray research facility

ARGONNE NATIONAL LABORATORY

Introduction to the APS

The Advanced Photon Source (APS) at Argonne National Laboratory is a national synchrotron-radiation light source research facility funded by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences.

Using high-brilliance x-ray beams from the APS, members of the international synchrotron-radiation research community conduct forefront basic and applied research in the fields of materials science; biological science; physics; chemistry; environmental, geophysical, and planetary science; and innovative x-ray instrumentation.

Researchers (or "users") come to the APS either as members of Collaborative Access Teams (CATs) or as General Users. Collaborative Access Teams are composed of scientists and engineers with common research objectives. These teams are responsible for the design, construction, funding and operation of beamlines designed to take radiation from the APS storage ring and tailor it to meet specific experimental needs. By agreement with the APS, Collaborative Access Teams must allocate a minimum of 25% of their x-ray beam time to General Users, who obtain time through a central proposal submission, review, and allocation system. For further information on obtaining beam time at the APS, go to User Info.

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APS Techniques Directory

Technique	Beamline
Absorption/Spectroscopy	
Fluorescence spectroscopy	18-ID
Photoemission spectroscopy (XPS)	4-ID-C
X-ray absorption fine structure (XAFS)	10-ID , 11-ID-D , 12-BM , 13-BM , 13-ID , 16-ID-B , 18-ID , 20-BM , 20-ID , 5-BM-D , 9-BM
X-ray magnetic circular dichroism (XMCD)	4-ID-C , 4-ID-D
High Pressure	
Diamond Anvil Cell (DAC)	13-BM , 13-ID , 16-ID-B
Multi-Anvil Press (LVP)	13-BM , 13-ID
Imaging	
EXAFS Microscopy	10-ID , 20-ID
Micro fluorescence	2-ID-B , 2-ID-D , 2-ID-E , 20-ID
Microprobe	13-ID , 2-ID-D , 20-ID , 34-ID , 7-ID
Phase contrast imaging	1-ID , 2-BM , 2-ID-B
Photoemission electron microscopy (PEEM)	4-ID-C
Tomography	13-BM , 2-BM , 5-BM-C
Topography	33-BM
Protein Crystallography	
Macromolecular crystallography	14-BM-C , 14-BM-D , 14-ID , 17-ID , 19-BM , 19-ID , 22-ID , 31-ID , 5-ID
Multi wavelength anomalous dispersion (MAD)	14-BM-D , 14-ID , 17-ID , 19-BM , 19-ID , 22-ID
Scattering	
Anomalous and Resonant Scattering	15-ID , 33-ID , 4-ID-D
Coherent x-ray scattering	2-ID-B , 34-ID , 8-ID
Compton scattering	16-ID-B
Diffraction anomalous fine structure (DAFS)	10-ID , 20-BM , 20-ID
Fiber Diffraction	18-ID
General Diffraction	11-ID-D , 12-BM , 2-BM , 20-BM , 20-ID , 33-BM , 33-ID , 7-ID
High energy x-ray scattering	1-ID , 11-ID-B , 11-ID-C , 5-BM-D , 6-ID-D
Inelastic scattering	13-ID , 16-ID-B , 3-ID , 33-ID
Liquid scattering	15-ID , 6-ID , 9-ID
Magnetic x-ray scattering	4-ID-C , 4-ID-D , 6-ID , 6-ID-D
Micro - diffraction	13-ID , 14-BM-D , 16-ID-B , 2-BM , 2-ID-D , 34-ID
Nuclear Resonant Scattering	16-ID-B , 3-ID
Polymer	5-BM-D , 5-ID
Powder diffraction	1-BM , 12-BM , 16-ID-B , 33-BM , 5-BM-C , 5-ID , 6-ID , 6-ID-D
Reflectivity	1-BM
Single crystal diffraction	33-BM
Small angle x-ray scattering (SAXS)	12-ID , 18-ID , 33-ID , 5-ID , 8-ID , 9-ID

Surface diffraction	33-ID , 6-ID
Time-resolved x-ray scattering	14-BM-C , 14-BM-D , 14-ID , 15-ID , 18-ID , 6-ID-D , 7-ID , 8-ID
Ultra-small Angle X-ray Scattering	33-ID
Wide angle x-ray scattering (WAXS)	15-ID , 8-ID
Miscellaneous	
X-ray Optics Development	5-ID

* denotes that the beamline will only accept a proposal for that technique if it is a collaboration with the CAT

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14-BM-D: Sector 14 - Bending Magnet D Branch Beamline

Current Status

Operational/Accepting General Users

Local Contacts

· KEITH E BRISTER - ph: 630.252.0451 ; email: brister@cars.uchicago.edu
· DIXIE L. FRANKLIN - ph: 630.252.0450 ; email: franklin@cars.uchicago.edu

Supported Techniques

·Macromolecular crystallography
·Multi wavelength anomalous dispersion (MAD)
·Micro - diffraction
·Time-resolved x-ray scattering

Discipline

·Life Sciences

Source

Bending Magnet

Beamline Specs

Energy Range	Monochromator Type	Resolution	Flux	Beam Size (horiz x vert)	
				Unfocused	Focused
7-18 keV	Si 111	1.5×10^{-4}	9×10^{10} @12.398 keV		500µm x 800µm

Beamline Controls and Data Acquisition

Beamline controls: HP9000/778 HPUX 10.2 running EPICS via VME experiment: SGI 02 IRX 6.3 running ADSC or MAR control software via in house (kbscan>software) analysis: fast SGI 02 IRIX 6.5 running DENZO, MOSFILM, DPS, etc...

Detectors

· ADSC Quantum-4
· ADSC Quantum-1
· MAR345
· mar CCD 165
· 60 degree kappa diffractometer (14-BM-D)
· single axis diffractometer (14-BM-C)
· Nal scintillation setectors
· Ge detectors

Additional Equipment

· cryo-coolers: Oxford CryoStream
· Oxford Cryo-Jet
· MSC

- CARS LN2LHe2 Cooler
- collimators, filters, slits, beam stop, CCD alignment camera
- beam position monitors (1 um resolution)
- beam flux monitors
- BL3 facility, sample prep areas, cold room

Operator

CARS Structural Biology Resource

CARS-CAT

Additional Information (Beamline URL)

All Publications

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v1.0.0.0-20020826.0

Research opportunities expand at nation's premier X-ray facility

ARGONNE, Ill. (Nov. 26, 2004) — The Advanced Photon Source (APS), located at Argonne National Laboratory and the premier hard X-ray research facility in the nation, each year hosts thousands of experimenters who carry out research that impacts nearly every aspect of our lives. Now, the outlook for this essential U.S. Department of Energy(DOE)-funded program is even brighter as changes in the way scientists access the APS are significantly increasing opportunities for experimentation.

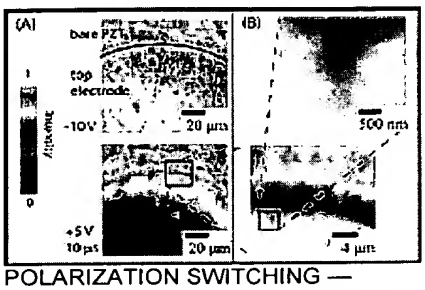
Access to those APS X-ray beamlines funded, like the APS itself, by the DOE's Office of Basic Energy Sciences (BES) has more than tripled since they came under the auspices of the X-ray Operations and Research (XOR) group in Argonne's Experimental Facilities Division. It's all part of a concerted effort by APS and DOE to make this national scientific asset even more open to experimenters whose research proposals can pass a competitive, peer-reviewed proposal evaluation process.

When the APS began operations in 1996, 25 percent of the research time on most beamlines was available for open, peer-reviewed research. With the creation of XOR, the availability at XOR-operated beamlines has soared to 80 percent. At the same time, the number of XOR-operated sectors has grown from four to 10 and will continue to increase.

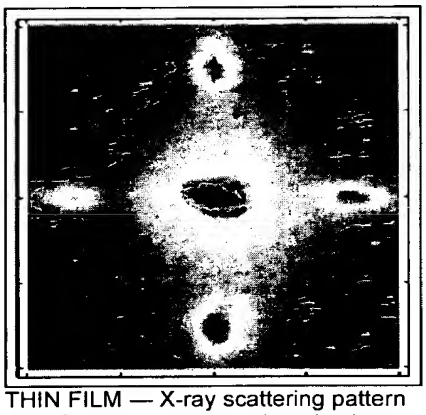
DOE's Office of Basic Energy Sciences set out to improve access to beamlines at the APS and other federally funded U.S. light sources to maximize the facilities' scientific and technical impact. At the APS, XOR was formed within the Experimental Facilities Division to operate the BES beamlines, to build new ones and to pioneer new fields of X-ray research.

"It is a natural choice for us to operate these beamlines," said Experimental Facilities Division Director Efim Gluskin. "Our division has conceptualized, designed and developed

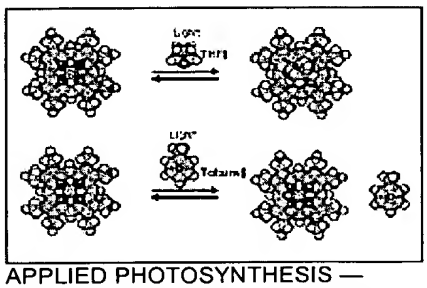
Resources



POLARIZATION SWITCHING — Microdiffraction images of polarization switching in a Pb(Zr,Ti)O3 thin film capacitor. Research on this and other ferroelectric materials could help lead to computer RAM and other memory devices that retain data even when turned off. *Click image to view a larger image with a more detailed caption.*



THIN FILM — X-ray scattering pattern from ferroelectric stripe domains in a thin film of lead titanate three unit cells thick. Research on ferroelectric thin films could lead to submicroscopic layered materials for use in various novel applications. *Click image to view a larger image with a more detailed caption.*



APPLIED PHOTOSYNTHESIS — Photoinduced ligation of excited-state CuOEP with solvent molecules studied by time-domain X-ray absorption.

innovative instrumentation for APS users. This instrumentation includes insertion devices that provide the extreme-brilliance X-rays, monochromators and mirrors that select the required X-ray wavelength while withstanding extremely high heat loads, and X-ray optics that focus the X-ray beam to spots smaller than a millionth of a meter." This work remains a main focus of the division.

Experiments at XOR-managed beamlines are uncovering new knowledge in chemistry, geoscience, bioscience and materials science. This research uncovers how sub-microscopic structural changes can lead to large changes in the properties of technologically important materials and develops pioneering research techniques that are expected to lead to new advances in chemistry, materials science and geologically important materials.

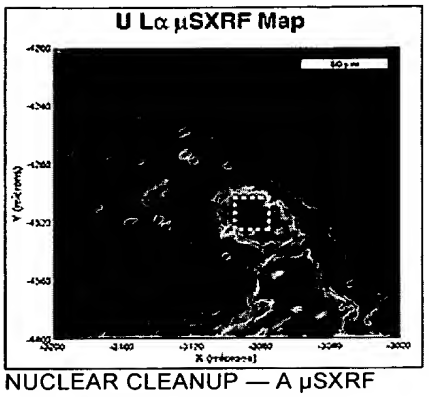
"Many research techniques available at the XOR-operated beamlines serve multiple scientific communities," explained Gabrielle Long, Associate Director of the Experimental Facilities Division. "It is intriguing that the same research technique that delivers geological information about the Earth's core can also provide critical information about systems as delicate as biological tissues."

Recent research at XOR beamlines

Recent research at XOR beamlines has led to new findings about the properties of ferroelectric materials, the way porphyrins – key molecules in photosynthesis – respond to light under different chemical conditions, and the difficulties of cleaning up contaminated soil at U.S. weapons-production sites.

Our current information technology relies on devices that process information as binary ones and zeroes. Ferroelectric materials are of special interest to developers of the next generation of such devices because they exhibit polarized electronic states that can represent bits of information. Moreover, these materials retain their polarization states without consuming electrical power, which makes ferroelectrics the subject of intense study for nonvolatile memory applications that can store data even when the power is turned off. One problem, however, is polarization fatigue: After a number of cycles, the ability to switch polarization tapers off, rendering the device unusable. Researchers used synchrotron

Studies of this and other porphyrins, key molecules in photosynthesis, could lead to future devices that store data with light rather than electricity. *Click image to view a larger image with a more detailed caption.*



NUCLEAR CLEANUP — A μSXRF map showing the heterogeneous uranium distribution occurring at the micrometer scale. This and related research is helping learn more about how to clean up contaminated soil at nuclear weapons production sites. *Click image to view a larger image with a more detailed caption.*

Scientific contact

- Gabrielle Long

Media contact

- Catherine foster

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radiation from the APS to study the micrometer-scale details of polarization fatigue in ferroelectric oxides. This research could help lead to computer RAM and other memory devices that retain data even when turned off.

Recent research at an XOR-operated beamline also showed that ferroelectric materials can retain their ability to function even when made into extremely thin films. The results show that a thin film of one particular ferroelectric material, lead titanate, is still stable even in a layer that is a mere 1.2 nanometers (three unit cells) thick. This tiny thickness limit for ferroelectricity bodes well for fabricating submicroscopic layers for use in various novel applications.

Square, flat molecules known as porphyrins are at the heart of natural and artificial photosynthesis, the conversion of sunlight into chemical energy. They provide a molecular springboard that captures photons of sunlight and bounces out energetic electrons. Porphyrins also have potential as light-powered catalysts and as components of photonics devices, such as information storage materials, that use light, rather than electrons to store data. Researchers used an XOR beamline to determine how different porphyrin molecules respond to being excited by light under different chemical conditions. Their findings could help scientists fine tune the chemical structure of porphyrins by changing the attached side groups and the metal ions at their center to respond to different wavelengths of light. Such modified porphyrins may one day form the building blocks of novel catalysts, photonic devices and efficient solar-power units.

Accidental releases of liquid waste from U.S. nuclear weapons production facilities have included large quantities of radionuclides, such as cesium, cobalt, europium, strontium, technetium, and uranium. These leaks at underground waste storage tanks, first built in the 1940s, have caused complex plumes of soil contamination. Researchers from Stanford University, Stanford Synchrotron Radiation Laboratory, Pacific Northwest National Laboratory and Argonne used an XOR beamline to study the properties and behavior of uranium in sediment samples from a contaminated site. The researchers concluded that the distribution and various chemical forms of uranium would likely make environmental remediation of the site difficult. But they also concluded that future release of uranium from

these sediments would be minimal.

Building beamlines

A number of new beamlines currently under construction at the APS will be operated by XOR. Chief among them is the nanoprobe beamline for Argonne's new Center for Nanoscale Materials. The nanoprobe will be a hard X-ray microscopy beamline with the highest spatial resolution in the world.

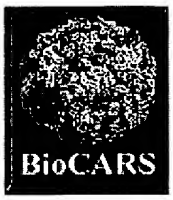
Nanomaterials contain structures only a few atoms across and exhibit properties different from bulk materials. While used in only a few products now, nanomaterials are predicted to grow into a trillion dollar industry. Nanotechnology is expected to open new possibilities in areas as diverse as superconductivity, computer memory media, electrical and thermal transmission, micro-switching devices and highly sensitive free-radical detectors. The nanoprobe beamline will combine fluorescence, diffraction and transmission imaging at a spatial resolution of 30 nanometers or better. The X-ray beam will probe samples under *in situ* conditions and provide information about the internal structure of nanomaterials.

Another innovative beamline will be a premier facility for inelastic X-ray scattering. This technique can, for example, measure the velocity of sound in liquid metals of importance to geoscience. Finally, a dedicated beamline is under construction to serve the needs of the X-ray powder diffraction community.

XOR is also playing a major role in strategic planning for future scientific development at the APS to attract new groups of researchers with exciting ideas for innovative X-ray science. These concepts will be the foundation for exciting new research at the remaining, uncommitted APS beamlines.

For more information, please contact Catherine Foster (630/252-5580 or media@anl.gov) at Argonne.

BioCARS Proposal Information



Principal Investigator: Keith Moffat 773-702-9950
User Administrator: Dixie Lee Franklin 630-252-0450
Scheduling: Keith Brister 630-252-0451

Note: BioCARS now accepts proposals through the APS General User program. This link brings up the APS web based proposal system. Please submit new proposals through the APS system. Request a BioCARS station (14-ID, 14-BM-C, or 14-BM-D) as your first choice to be fully considered for BioCARS time.

To be considered for the February-April 2005 run you **must** submit a "Rapid Access" beamtime request AND request a BioCARS Station as yourfirst choice.

BioCARS is planning an upgrade of the 14-ID-B station with construction starting as early as April 2005. This upgrade will prevent us from performing MAD or Laue experiments until at least the winter of 2006. In your beamtime request on the APS Website, please be sure to select **Any Appropriate Beamline** to maximize the possibility your request can be satisfied.
BioCARS will work with the APS and other facilities to minimize the near-term negative impact this upgrade will have on your research program.
Current Status: Preliminary Design Report Under Internal Review

Please contact Keith Brister at 630-252-0451 (brister@cars.uchicago.edu) or Dixie Franklin at 630-252-0450 (franklin@cars.uchicago.edu) if you have any questions.

- Register to become a BioCARS Database User
- Login here!

BioCARS receives funding from the National Institutes of Health National Center for Research Resources under grant RR07707.

More about the Consortium for Advanced Radiation Sources (CARS)

More About BioCARS

Security/Privacy Notice

The BioCARS Proposal Submission Process

Please submit your proposal through the APS proposal system UNLESS you have contacted BioCARS and have been instructed to submit a proposal directly to BioCARS.

Questions? Contact Keith Brister

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Security/Privacy Notice

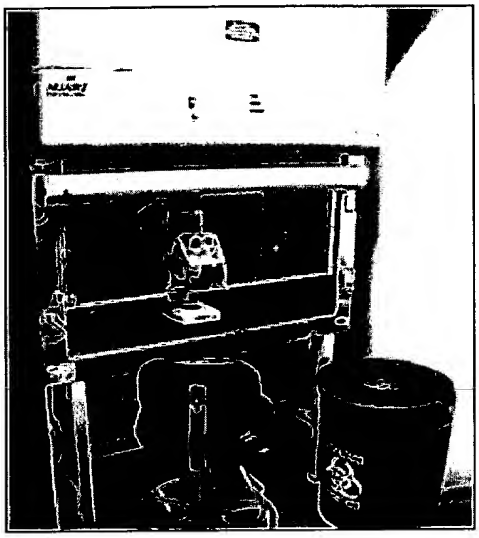
BioCARS is **not** operated by the Department of Energy, Argonne National Laboratory, or the Advanced Photon Source. Nevertheless, this site may be governed by the Department of Energy security and privacy statement.

Biosafety Level 3

BioCARS is the only facility at Argonne National Laboratory designed and constructed for work with samples classified as Biosafety Level (BSL) 2 or 3 substances.

All stations and control areas can be operated in BSL2 and BSL3 modes, with all necessary engineering controls and standard operating procedures in place for safe conduct of BSL2 and BSL3 experiments.

A biosafety cabinet is installed for preparation and mounting of BSL3 samples.



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of the National Institutes of Health

Cryocrystallography

Crystal Coolers | Loop Mounts | Flash Cooling | Liquid Nitrogen Supply | References

Cryocrystallography has become an essential and routine tool in structural biology over the last decade as a result of observation of great reduction in radiation damage to protein crystals during X-ray diffraction experiments at cryotemperatures (Low et al., 1966; Haas and Rossmann, 1970). As radiation damage was becoming a limiting factor in the utilization of synchrotron radiation sources in the early 1990s, a simple loop-mounting method was developed for cryocrystallography by former BioCARS staff scientist Tsu-Yi Teng (Teng, 1990). The method is now widely and routinely used by the majority of protein crystallographers at synchrotron and laboratory X-ray sources.

Equipment and tools for cryocrystallography are offered to users in all three BioCARS experimental stations.

- Low, B. W., Chen, C. C. H., Berger J. E., Singman, L and Pletcher, J. F. (1966) PNAS USA **56,** 1746-1750.
- Haas, D. J. and Rossmann, M. G. (1970) Acta Cryst. **B26,** 998-1004.
- Teng, T.-Y. (1990) J. Appl. Cryst. **23,** 387-391.

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BioCARS Beamlines

14-ID-B Station | 14-BM-C Station | 14-BM-D Station

BioCARS facility operates three experimental stations: one insertion device station, 14-ID-B, with either an undulator or a wiggler source and two bending magnet stations: 14-BM-C and 14-BM-D.

A kappa geometry diffractometer is available in all three BioCARS stations.

All stations and their control areas are embedded in a Biosafety Level 3 (BSL 3) facility, unique at the APS, that permits safe research on bio-hazardous materials, such as pathogenic human viruses.

Click the following link to see a Sector Overview Plan (110k).

For a **Gallery of structures solved at BioCARS beamlines** (from Protein Data Bank), please click on any of the links below:

- 14BM-C Gallery
- 14BM-D Gallery
- 14ID-B Gallery

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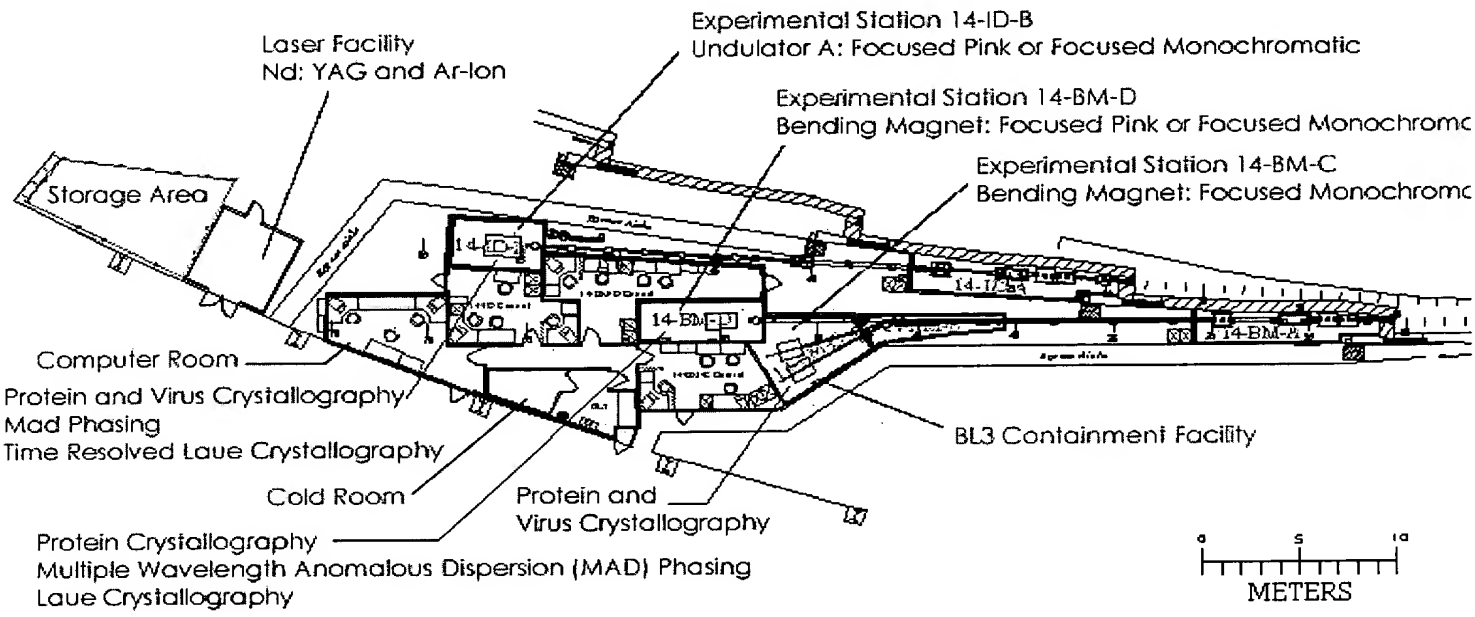
BioCARS

Sector 14 - Overview



« Go Back

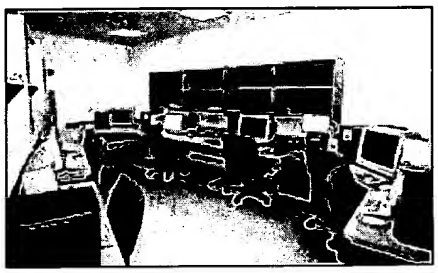
Computer Resources

Software | Data Backup | Processing Computers

BioCARS provides the users with a variety of hardware and software resources in order to view, process, and store diffraction data. This gives users the opportunity to process their data before returning to their home institution.

Many software packages are available on both SGI (IRIX) and Redhat Linux computers. These are usually updated on a regular basis.

The final step during the synchrotron trip is usually the process of backing up the large amount of data that gets generated. Several backup options are available to the users.



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Data Backup

Computer Resources > Data Backup

Tape Backup | CD Backup | DVD Backup | Firewire | Laptop Backup | SnapServer

Mac Users

Backing up your data properly is as important as collecting good data in the first place. The **data collected during a visit will be cleared from a station** a day or two **after the users are gone.**

As soon as you complete a project, you should back up your data to tapes, CD, DVD, or a firewire drive. Many users are also transferring their data by ftp to their home institution. Other options are also available such as transferring data to a Macintosh, a laptop (especially one with a firewire drive) or using a SnapServer for storage.

Although users are ultimately responsible for backing-up their own data, BioCARS backs up data to the TeraByte facility after the users have left. This data can be retrieved through the BioCARS database. We try to keep the data on the TeraByte facility for about six months.

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Chemistry Lab

The Chemistry Lab is available for BioCARS users for sample preparation and storage during their experiments. Available equipment includes:

- Microscope (Leica Zoom 2000)
- Balances (Denver Instruments XP-300, max 300g, 0.01g and AP-100, max 100g, 0.1mg)
- Eppendorf Centrifuge 5415C
- Fisher Scientific Vortex Center
- ph meter (Fisher Scientific Accumet Research AR15)
- Refrigerator and incubator (Fisher Scientific Low Temperature Incubator) for user samples.

Limited lab and chemical supplies are available.

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Cold Room

The BioCARS facility has a cold room available to users for sample preparation and long-term storage. The cold room includes the following features:

Temperature maintained at 4°C (+/- 0.1°)
Back up power to maintain temperature during a power failure
Individual locking cabinets for long term sample storage
Ample work surfaces with basic equipment for sample preparation

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